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ELECTRIC SHOCK

WITH REPORT OF AN UNUSUAL CASE

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THE subject of injury produced by currents of electricity passing through the body attracts the attention of the industrial surgeon; of the medical examiners of accident insurance companies; less often that of the general practitioner; and only occasionally is a case referred to the neurologist.

The case reported at the close of this article, however, has two features of neuropsychiatric interest, and seems worthy of the somewhat detailed description given.

The literature on the subject of electric shock is scanty, and is largely to be found scattered in brief reports and small paragraphs. England has produced a much more extensive literature than the United States, including at least one standard textbook; and Dr. Willem Einthoven of the University of Leiden received one of the Nobel prizes of 1925 for his contribution to the general subject under the title, "Electricity and Nerves."

Since the subject has a threefold interest and appeal, namely—to the medical profession, to the scientific and engineering group, and to industrial concerns, the appointment of the "Commission on Electric Shock" was a logical step. This was composed of representatives of the American Medical Association, the American Institute of Electrical Engineers, and the National Electric Light Association. Nearly a year was devoted to an investigation of the subject, and a handbook and chart, with rules for the resuscitation of victims of electric shock was issued. These rules have been in large demand for distribution to workmen and for display in factories.

The government of Canada has adopted the rules officially, and has called the attention of all Canadian railways to them. Authority has been given for reprinting the same in several foreign languages.

It is estimated that these rules have been printed either in full or in abridged form about five million times. They may be obtained from the National Electric Light Association, and form a worthwhile addition to the library of any physician.

A humanitarian work of such scope, tending to prevent accidents and to save life, is deserving of more than passing mention. The valuable results to be secured through coöperation between the medical profession and enlightened business men are here well exemplified.

SUMMARY OF URQUHART'S REPORT

Some valuable experimental work done in this field by R. W. I. Urquhart has been reported in the *Journal of Industrial Hygiene*.

The summary of this article deserves to be quoted in full.

"1. The experiments herein described confirm the deductions of previous observers as to the cause of death in electric shock, namely, that it may be due to primary cardiac failure, to primary respiratory failure, or to a combination of both.

"2. In laboratory animals, when the current traverses the body from the head to a hind limb, about 45 per cent of the deaths are of purely cardiac origin. The remainder of the deaths occur because of failure of the respiratory movements.

"3. In these, as in the group in which the current is passed directly through the brain, a condition of profound paralysis or block becomes established in the respiratory, vagus, and vasomotor centers.

"4. That the block involves these centers is shown by experiments which demonstrate clearly the absence in electrocuted animals of reflex effects normally functioning through them. Since the nerve centers become insensitive to extraneous influences counterstimulation is not an aid to recovery.

"5. No definite histologic changes can be made out in the brain to account for the symptoms. The capillary hemorrhages which occur do not appear to be significant.

"6. The foregoing experiments also show defi-

nitely that when the electric current does not cause charring of nerve structures the paralysis or block is recovered from and the reflexes return, provided efficient artificial respiration is applied.

"7. It is of the greatest importance that artificial respiration be applied early and be maintained for a sufficient length of time. Owing to the nature of the block in the nerve centers the ordinary tests for death should not be accepted and 'nothing less than cooling of the body or the onset of rigor mortis should be considered to be evidence of death.'"

In regard to time during which artificial respiration should be carried out, Tousey in the *International Journal of Medicine and Surgery* states that three hours should be a minimum. He calls attention to the fact that even where apparently instantaneous death has occurred, resuscitation methods may succeed if persevered in for a sufficient length of time. He further states that a 110-volt current may be fatal if the person is grounded, and that voltages higher than this are dangerous under all circumstances.

A special interest attaches to this hazard because it is a preventable one, and seldom can the fatality or injury be classified as due to an "act of God." The carelessness of workers, the absence of safety devices in connection with machinery and the distribution of power are responsible for the vast majority of casualties.

CASE REPORT

The case which is here reported is that of a young man of twenty-four, in good physical condition, height 6 feet and 2 inches. He was employed in wiring the switchboard in a smelter connected with the United Verde Copper Company. Through some mischance a current was short-circuited from one hand to the other while he was changing the leads from a current transformer. He stated that the current was of low amperage, though varying somewhat from time to time. The voltage was not a fixed quantity, but started very low, and gradually increased after the circuit was closed, a maximum of 1000 or 1500 volts being possible.

The patient's description of his sensations and his psychological reactions was of great interest to the examining physician. The first sensation noticed was of a terrible crushing pressure, not translated into pain, as the word is ordinarily used. This affected the entire musculature, but was most marked in the arms and shoulders—the current passing through the hands and across the body. No sensation of heat or burning such as is frequently mentioned by the subject of electric shock was noticed.

Simultaneously with the sense of crushing pressure occurred a tremendous stimulation, both mental and physical, beyond anything in the patient's experience, and accompanied by a great surge of elation and a vast sense of power.

The next item noted was disturbance of vision, with various colors whirling more and more rapidly before the sight. From the description given these sensations and images were similar to those occurring in the early stages of chloroform anesthesia. Progressive loss of vision accompanied these sensations, ending in complete blindness while consciousness was still present and unimpaired.

Loss of ability to hear outside noises was accompanied by a sensation of hearing a loud humming or whirring noise. This noise the patient said was already associated in his mind with a current of the same frequency as the one passing through his body, under circumstances rendering it audible, and the question whether it was subjective or objective arose in his mind. Complete unconsciousness gradually supervened.

The time that elapsed before the man was released from the contact by a fellow workman who happened to approach is not known. The patient on regaining consciousness was entirely clear mentally and was able to swear vigorously at a worker who was nearby when the accident occurred and who had stood incapable of action and rooted to the spot, with his mouth open and with a horror-stricken countenance.

The patient, during the stage of seconds or minutes—he had no knowledge of the passing of time—was sure that death was at hand, but felt no fear whatever. He was conscious only of a mighty rage directed at the paralyzed man who stood in the line of his vision without making a movement to rescue him. The patient, of course, could not speak nor express his inward rage as he gazed.

The first after-effects noticed were extreme pain over the brachial plexus on each side, radiating over the area supplied by the plexus. This burning pain prevented sleep entirely for several nights, and continued uninterrupted, but with gradual diminution, for three weeks or more. About four days after the injury, blisters appeared, and a herpetic eruption followed, covering an area of not less than 100 square inches, on either side of the thorax, and almost meeting in front. This was not quite symmetrical, the upper margin on one side being somewhat higher than the other. The pain, however, seemed to the patient to cover exactly the same area on each side. This herpetic eruption lasted about three weeks, and gradually faded away, as in herpes from any cause.

There was no pain on breathing or coughing. The pain caused by using the arms was severe, but not unbearable, and the man resumed his work the next day, but spent several nights walking the floor, unable to sleep on account of pain.

The muscles of the arms and chest were exceedingly sore to the touch for some three or four weeks, but gradually became entirely normal.

The only local effect on the hands, which were not painful, was that a small core of entirely carbonized flesh sloughed out of a cylindrical matrix on one finger of each hand, the right hand preceding the left by a few days. The skin was not discolored on the hands or arms, nor elsewhere except as normally follows a herpetic eruption.

There was no permanent impairment of function in any way nor did the general health appear to suffer. No residuum exists, after a period of several years, except that the patient feels a wave of anger still when he thinks of the vacant countenance of his fellow worker, which he thought was the last sight his eyes would behold on this earth.

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MANAGEMENT OF HEART CONDITIONS IN CHILDREN*

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BETWEEN eight and nine thousand children in Los Angeles public schools suffer from heart trouble in some form. These cases had been handled in a rather haphazard manner with nothing accomplished from a constructive standpoint. In the spring of 1925 the Director of Health and Physical Education of the Los Angeles public schools called together a few men interested in heart conditions in children, to formulate a plan to give these children with heart disease

* A review of the work done by the Consulting Heart Board of the Los Angeles public schools.

* Chairman's address, Pediatrics Section, California Medical Association, at its Fifty-seventh Annual Session, April 30 to May 3, 1928.